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(54) Adjustable Telescopic Device

(57) A vertical telescopic device has an inner tube (21) which carries a load such as from the seat of a chair and is slidably mounted in an outer tube (23). The tubes are adapted to be locked together by rolling grippers (37) releasably spring-loaded from below and wedged between the outer tube and downwardly tapering faces (38) of the inner tube. To avoid the risk of deforming the tubes by the rolling elements due to high point loadings, the rolling grippers (37) are shaped as rollers with a surface generatrix matching the inner face of the outer tube. The said tapering faces (38) also have a corresponding cross-sectional shape. In a structure where the spring member (34) loading the rollers (37) also serves for extending the device in the released condition, additional locking rollers (57) are wedged between the outer tube (23) and upwardly tapering faces (58) which are also subjected to the spring load, to assist in locking.

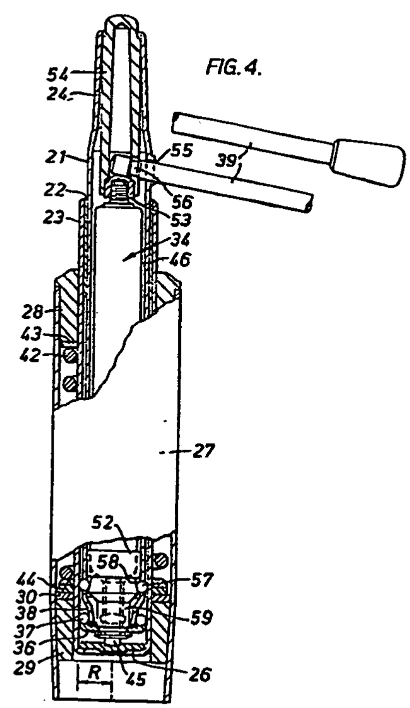

FIG. 4.

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FIG.1.

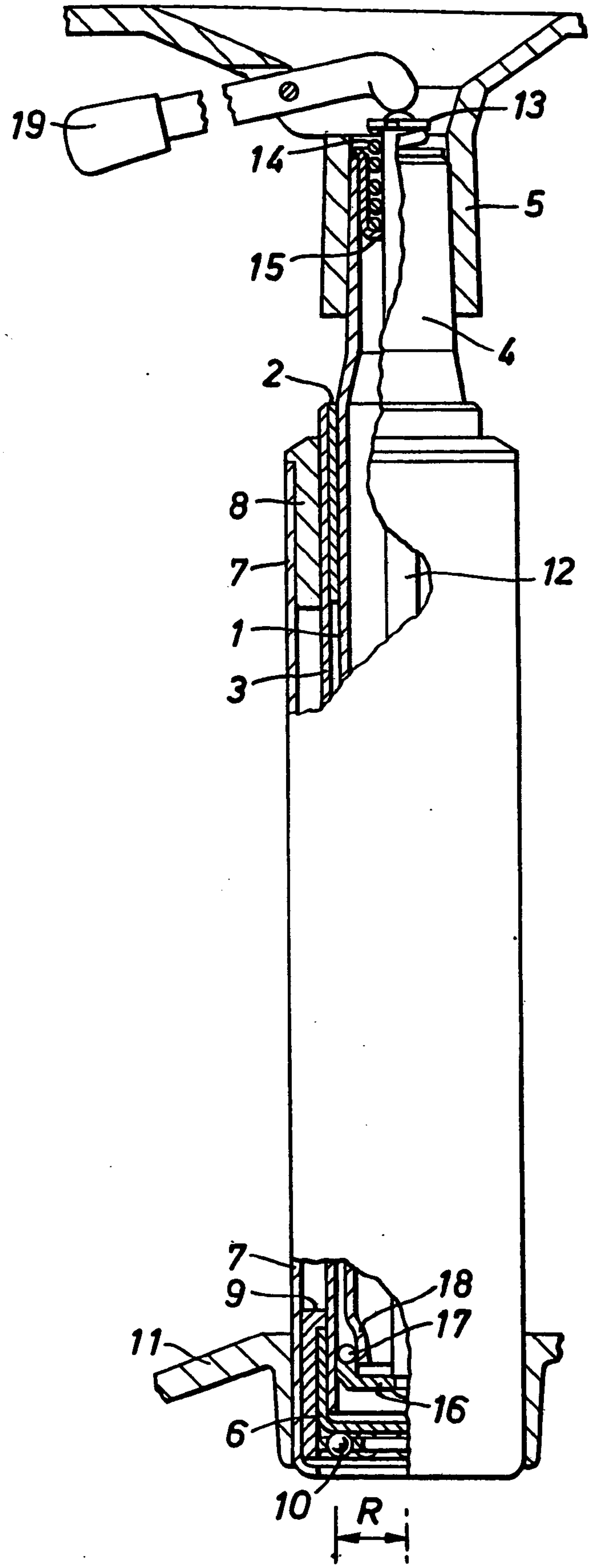

FIG.2

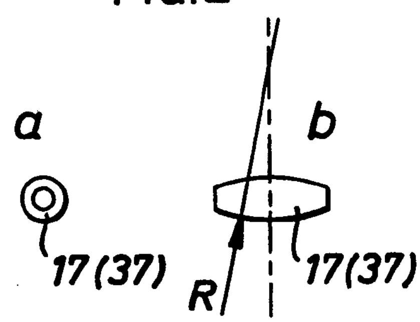

FIG.3.

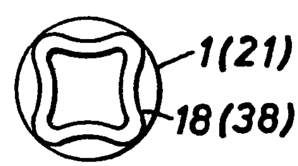

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FIG. 4.

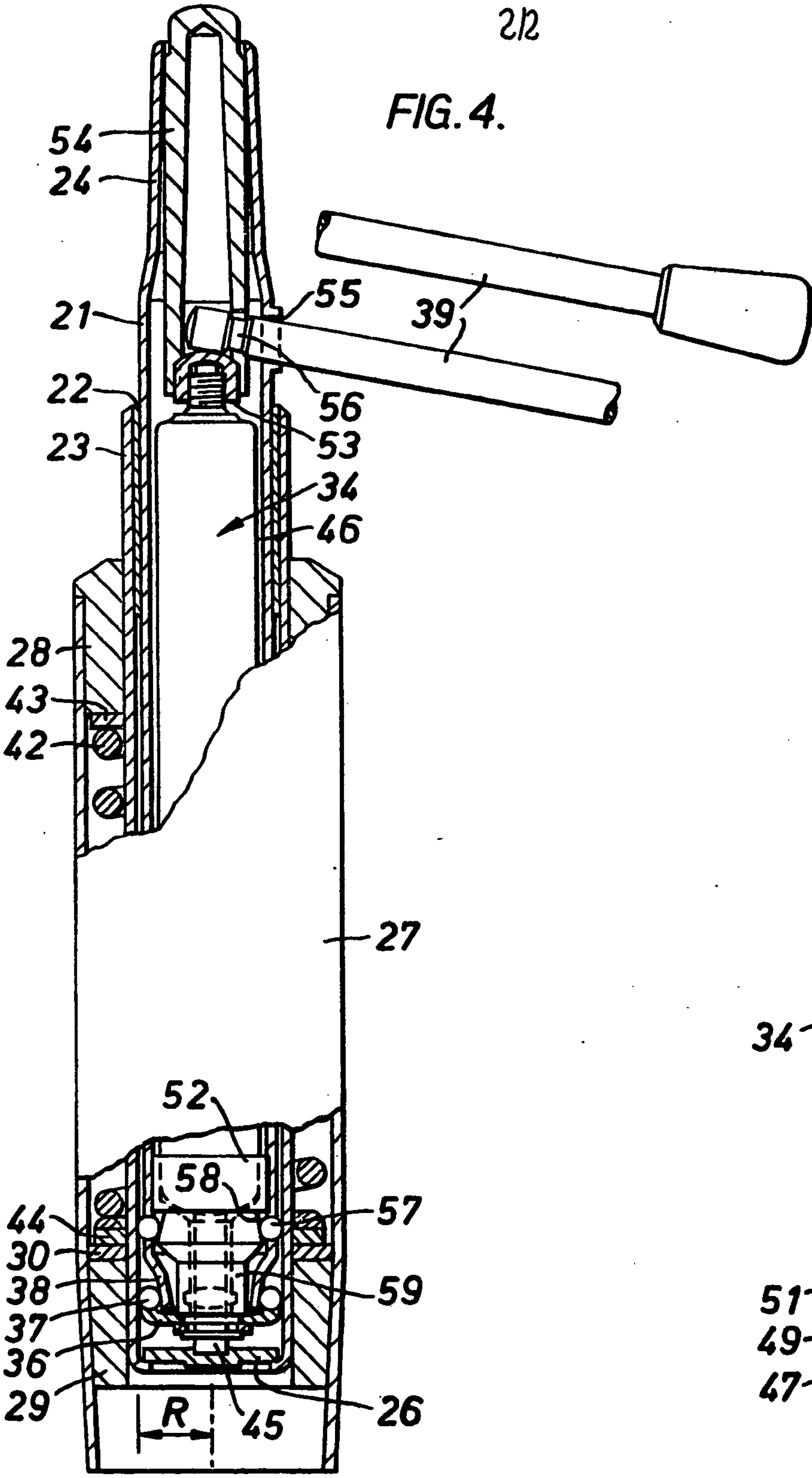
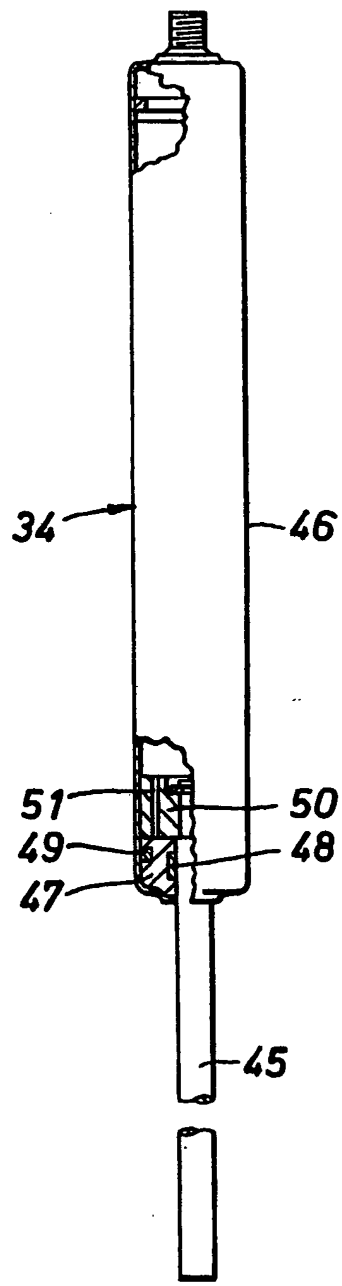


FIG. 5.



SPECIFICATION
Adjustable Telescopic Device

The invention relates to adjustable telescopic devices of the kind designed for mounting in a substantially-vertical orientation and having an inner tube which is slidably inserted in an outer tube and projects from the upper end of the outer tube and which is adapted to carry a load and near its lower end and can be locked to the outer tube. The invention has been developed with a view to being used in spindles for adjustable working chairs, that is where the load is constituted by the weight of the user in addition to that of the seat and possibly the back of the chair, but it may also be used in several other situations such as for adjustable table legs, scaffold legs, stays for agricultural implements etc., where a height adjustment is required.

The possibility of adjusting the height of working chairs is very important in many situations, especially where the same working place is used by different persons at different times, since a correct sitting level is important for the physiology and comfort of the user. But in order that this possibility is really constantly utilized when the demand arises, it is necessary that the adjusting system can be operated quickly and from seated position even by persons without special technical knowledge.

For this purpose telescopic devices of the kind referred to are frequently used, and a problem in that connection is to combine the possibility of easy operation with safe locking in adjusted positions. In many telescopic devices the locking takes place by some form of wedging action by using axially movable spring-loaded wedges which either press tongues of the inner tube outwards towards the outer tube or are wedged between inner and outer tube. However, here a difficulty resides in that, although a small wedge angle ensures safe locking, it requires a great force for the release, whereas with greater wedging angles the locking becomes less safe. The use of wedge pieces between the outer tube and downwardly tapering faces on the inner tube has been mentioned already in the German Patent Specification No. 130 366 from 1901, but that specification also describes and shows a different possibility, i.e. to replace the wedge pieces by balls actuated from below by a spring-loaded disc. With this device locking will take place by wedging of the balls under the spring load and be the more firm the greater the weight resting on the seat, whereas for adjusting movements in retracted position of the disc only rolling friction has to be overcome.

A drawback in that connection is, however, that under heavy load from the weight of the user the balls will exert a heavy point stress on the outer tube by outward forces with the result that the outer tube may be deformed and gradually become permanently damaged, so that the function becomes unsatisfactory and operation from a seated position will no longer be possible.

The present invention affords in this respect a satisfactory solution which is well compatible with all demands of importance that are made on a height adjustment for a chair and is applicable both in simple and inexpensive forms and in advanced designs.

The invention consists of an adjustable telescopic device for mounting in a substantially vertical orientation, the device comprising an outer tube, an inner tube which is slidably inserted in the outer tube and projects from the upper end of the outer tube, and means for locking the inner tube at its lower end to the outer tube, and locking means comprising rollers which are pressed up between the inner face of the outer tube and downwardly tapering faces of the inner tube so as to be wedged therebetween by means of a spring-loaded supporting element, the rollers being releasable from their locking position by manual actuation of the supporting element against the spring load, the circumferential face of the rollers being shaped with a generatrix corresponding to the cross-sectional shape of the inner face of the outer tube. The tapering contact faces of the inner tube are preferably made with a cross-sectional shape substantially corresponding to the generatrix of the rollers.

Since the locking in all adjusted positions thereby takes place by linear contact of the engaging faces it becomes possible to obtain both a safe and sure clamping and easy release without the risk that deformations with undesirable influence on the function will occur, even after prolonged use with frequent adjustments.

In advanced embodiments in which the spring means which causes the locking, is also used for extending the telescopic device, that is for raising the seat in the released condition, an additional safeguard against unintentional displacement may consist in that between the inner face of the outer tube and upwardly tapering faces of a part connected to the supporting element, there are inserted additional rolling elements which in the locked position of the device contribute in locking against upward pulling of the inner tube.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings of which:—

Figure 1 shows in elevation and partly in axial section a chair spindle including a simple embodiment of the telescopic device according to the invention;

Figures 2*a* and *b* are an end view and a side view, respectively, of a roller used in the locking system of the telescopic device of Figure 11;

Figure 3 is a bottom view of the inner tube of the telescopic device;

Figure 4 shows an axial section of a preferred advanced embodiment of a telescopic device according to the invention; and

Figure 5 shows in elevation and partly in axial section a so-called gas spring used as a combined locking and lifting spring in the embodiment shown in Figure 4.

In Figure 1 the telescopic device shown includes an inner tube 1, which is slidable vertically in a bearing 2 in the outer tube 3 of the telescopic device and at the top projects upwards from the outer tube with a conically tapering end portion 4 suited for having mounted thereon a corresponding fitting 5 which for example may carry a chair seat directly or through a pivotal fitting or the like. The outer tube is closed at its lower end by a bottom 6 and is rotatably supported in a surrounding box 7 by radial bearings 8 and 9 and an axial ball bearing 10. The box 7 is in turn mounted with its lower end in the bottom frame of the chair, diagrammatically indicated at 11.

A rod 12 extending axially through the inner tube 1 is supported at its upper end by means of a washer 13 riveted thereto and engaged by a helical spring 14 surrounding the tube and mounted in a spring box 15 which is inserted in the upper end of the tube 1 and rests with a flange on the end surface of the latter. Riveted to the lower end of the rod 12 is a disc-shaped supporting element 16, which is located below the lower end of the tube 1 and at its edge supports rolling elements 17, which are evenly spaced around the circumference of and in contact with the inner face of the outer tube 3 and with downwardly tapering outer faces 18 of the inner tube 1. As shown in Figure 2 the rolling elements 17 are constituted by barrel-shaped rollers, the circumferential surface of which is defined by a generatrix in the form of a circular arc having the same radius R as the inner face of the outer tube 3, which in the embodiment shown, like the inner tube 1, has circular cross-section as is usual. Even the contacting faces 18 of the inner tube 1 have as shown in Figure 3, a corresponding transverse curvature with radius R, so that the rollers 17 make linear contact with both tubes. Thus, under the action of the spring 14 the disc 16 presses the rollers 17 up into the space between the tubes so as to lock them together, and to this effect the spring 14 and the inclination of the contacting faces 18 are adapted for affording a safe locking force. It will be understood that the spring force required will be modest relative to the radial pressing force on the rollers 17, because of the mechanial advantage arising from the sloping plane-action of the faces 18.

The locking system is released for length adjustment by means of a lever 19 which is accessible to the user in seated position and which is pivoted in the fitting 5 at 20. The inner extremity of the lever engages the upper end of the rod 12, so that the supporting disc 16 is pressed down by lifting the lever 19. In absence of pressure from the disc 16 it will be possible to raise and lower the inner tube 1, the rollers 17 only affording resistance by rolling friction so long as the lever is kept lifted. During the adjustment, which takes place manually by raising or lowering the seat with the inner tube 1, the user will in this case have to lift himself off the seat, but he will not have to rise. When the adjustment has been terminated he releases the lever 19, so that the rollers 17 again adopt the locking position, and the locking action is enhanced when he then sits down anew, as his weight will have the effect of wedging the rollers 17 more firmly.

Whilst the design shown in Figure 1 is inexpensive and is satisfactory for many applications, especially for example for simple office chairs, the design shown in Figure 4 is far more advanced, especially with respect to increased comfort. In this figure, components having the same or corresponding function as those in Figure 1, have been designated with the same reference numerals increased by 20.

The telescopic tubes 21 and 23 with sliding bearings 22 are in all substantial respects identical to those in Figure 1. Further, the outer tube 24 is here likewise rotatably mounted in a surrounding box 27, but is supported from the same via an intermediate shock-absorbing helical spring 42 acting between a washer 43 fixed to the tube 23 and in frictional engagement with the bottom side of the upper radial bearing 28, and the upper part 44 of an axial sliding bearing 30 on top of the lower radial bearing 29, so that in free condition of the telescopic device the spring 42 serves for preventing undesired rotation of the latter.

However, the main difference from the first embodiment resides in that the spring load on the supporting disc 36 for the rollers 37, which otherwise are shaped and arranged in the same manner as in the first embodiment, is in this case afforded by a so-called gas spring 34 which also serves for raising, i.e. for extending the telescopic device upon release of the locking system.

Although gas springs having these two functions in chair spindles are well known, for the sake of clarity such a spring has been shown in Figure 5 and will briefly be described. It consists of a piston in the form of a rod 45 slidably and sealingly inserted in one end of a cylinder 46 through a sliding bearing 47 with outer and inner gaskets 48 and 49, respectively, and guided within the cylinder with a piston head 50 attached to it by screwing. The cylinder 46 is closed and filled with a gas, for example nitrogen, under high pressure. The piston head 50 is formed with one or more passages 51. So that the pressure will constantly be the same on both sides of it. Consequently, in any position of the piston in the cylinder, a resultant force will act between them in direction of extension equal to the pressure times the cross-sectional area of the piston rod. Since the force is inversely proportional to the gas volume, which varies with displacement of the piston in the cylinder by an amount corresponding only to the volume of the part of the piston rod 45 projecting into the cylinder, the force on the piston will be very nearly constant irrespective of its position in the cylinder. In the position shown in Figure 4 the inner tube 21 practically adopts its lowermost position in the outer tube 23 and the rod 45 is very near to its

innermost position in the cylinder 46. The supporting disc 36 is attached by a spring washer to the lower end of a sleeve-shaped extension 59 attached by a cap 52 to the lower end of the cylinder 46. Due to the piston being supported by the bottom 26, the cylinder 46 of the gas spring will therefore constantly tend of move upwards, and consequently the supporting disc 36 will press the rollers 37 up between the inner face of the outer tube 23 and the downwardly tapering faces 38 of the lower tube 21.

Releasing is effected by displacing the cylinder 46 and hence, through the extension 59, also the supporting disc 36 downwards relative to the inner tube. To this effect a pressure is exerted on a button 53 screwed onto an extension pin on the upper end of the cylinder 46. This may be effected in the same manner as shown in Figure 1 by pressing a lever similar to the lever 19 against the upper end of a hollow extension 54 placed on the button 53. However, in the embodiment shown in Figure 4 a different arrangement is used, which is suitable in cases where the fitting to be mounted on the device is not equipped in the manner described. In the case shown a lever 39 is supported for limited pivotal movement in an orifice 55 in the wall of the inner tube 21 and also extends throught a cut-out in the wall of the hollow extension 54, where it is held in position with an annular groove 56. The extension 54 is in non-rotational engagement with the button 53 and can be pulled off from the same so that it will be possible in absence of the lever 39, that is at the stage of initial mounting or for later correction, to screw the button 53 up or down so as to perform a fine adjustment of the path of displacement of the supporting disc (36) relative to the inner tube 21 and thereby to obtain both a full clamping action and complete release exactly as intended.

In released position the cylinder 46 with the disc 36 can be displaced freely up or down, and by removing sufficient weight from the inner tube the gas spring 34 will thereby lengthen and via the support for the lever 39 entrain the inner tube upwards for lifting the seat. The force of the gas spring is conveniently arranged so that it will be overcome under the weight of an adult person sitting in the chair, but is more than sufficient for lifting the seat when not loaded, so that the displacement in released position will take place automatically up or down according to whether the load on the seat is removed or persists. A force of about 40—45 kilopond is usually regarded as adequate.

As mentioned above the rollers 37 afford good safety against unintentional shortening of the telescopic device under load, since they are merely clamped harder the greater the load, and on the other hand unlocking may nevertheless be effected with a relatively moderate force, since only rolling friction has to be overcome. Yet, the latter fact may in certain situations involve a risk of an undesired effect, since in case the rollers have not been wedged forcibly and the chair is lifted, it might occur that the system is unlocked, so that the gas spring 34 entrains the supporting disc 36 and hence the rollers 37 upwards, and the telescopic device is thereby lengthened unintentionally.

To prevent this risk additional rollers 57 have been inserted with ample play in orifices in the inner tube 21 above the inclined faces 38 and are in the locking position engaging the outer tube 23 and upwardly tapering faces 58 of the sleeve 51. In the locking position when the gas spring 46 urges the sleeve 51 upwards, the rollers 57 can thereby enhance the locking action of the rollers 37, whereas they are liberated when a pressure is exerted on the gas spring with the lever 39. And when such a pressure does not exist, if the locking effect of the rollers 37 should fail, the locking action of the rollers 57 will persist and even be enhanced due to these rollers being pressed more firmly against the outer tube.

In this manner the telescopic device is safely locked against displacement both upwards and downwards, so long as the locking action is not released intentionally with the lever 39.

The rolling elements 57 and the faces 58 may conveniently be shaped in a manner corresponding to that of the rolling elements 37 and the faces 38. But since this locking system is never exposed to excessive load by heavy persons, the risk of permanent deformation of the outer tube is in this case less pronounced, so that it might be possible to use ball-shaped rolling elements at this location.

The embodiment shown in Figure 4 distinguishes itself by particularly good permanent functional safety not only for the reasons mentioned but also because the gas spring is only working when adjustments are performed, and otherwise is firmly locked, so that the sliding seal between piston and cylinder is not subjected to constant wear. The desired resiliency of the chair in use is afforded by the spring 42, which in addition, due to the braking action of the washer 43, ensures that the seat does not rotate unintentionally when not loaded, whereas the braking action is removed as soon as the spring 42 is slightly compressed when the seat is loaded, so that the seat can be turned freely by a person sitting on the chair.

It will be understood that the invention may be carried out in many other ways than those described above with reference to the drawings. In addition to being capable of being used for other applications than for chair spindles, which may involve adaption of the design to the applications concerned, the use of the invention is inter alia not restricted to structures where the telescoping tubes have circular cross-section, since also polygonal cross-sections may be contemplated, and it will also be possible to use the invention in connection with telescopic devices having more than two telescoping tubes.

Claims

1. An adjustable telescopic device for

mounting in a substantially vertical orientation, the device comprising an outer tube, and inner tube which is slidably inserted in the outer tube and projects from the upper end of the outer tube, and means for locking the inner tube at its lower end to the outer tube, the locking means comprising rollers which are pressed up between the inner face of the outer tube and downwardly tapering faces of the inner tube so as to be wedged therebetween by means of a spring-loaded supporting element, the rollers being releasable from their locking position by manual actuation of the supporting element against the spring load, the circumferential face of the rollers being shaped with a generatrix corresponding to the cross-sectional shape of the inner face of the outer tube.

2. A telescopic device as claimed in Claim 1, in which the tapering contacting faces of the inner tube have a cross-sectional shape corresponding substantially to the generatrix of the rollers.

3. A telescopic device as claimed in Claim 1 or 2, in which the spring loading for locking is exerted by a member which also serves for lifting, addition rolling elements being inserted between the inner wall of the outer tube and upwardly tapering faces of a part connected to the supporting element the additional rolling elements assisting in locking against upward pulling of the inner tube when the device is in the locking position.

4. A telescopic device as claimed in Claim 3, in which the said part is included in the operating system for the supporting element and is located within the inner tube and the additional rolling elements are movably accomodated in orifices in the wall of the inner tube.

5. A telescopic device as claimed in any of the Claims 1—4, in which an adjustable member is inserted in the mechanical connection between a manual operating member with a limited range of motion for the relative displacement of supporting element and the inner tube for adjusting the path of displacement.

6. A telescopic device substantially as hereinbefore with reference to the accompanying drawings.

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